V International Conference on Digital Education at Environmental Universities

Olena H. Kuzminska[1], *Olena G.* Glazunova[1] and *Serhiy O.* Semerikov[2,3,4,5]

[1]*National University of Life and Environmental Sciences of Ukraine, 15 Heroyiv Oborony Str., Kyiv, 03041, Ukraine*
[2]*Kryvyi Rih State Pedagogical University, 54 Gagarin Ave., Kryvyi Rih, 50086, Ukraine*
[3]*Kryvyi Rih National University, 11 Vitalii Matusevych Str., Kryvyi Rih, 50027, Ukraine*
[4]*Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine*
[5]*University of Educational Management, 52A Sichovykh Striltsiv Str., Kyiv, 04053, Ukraine*

Abstract. This is an introductory text to a collection of selected papers from the V International Conference on Digital Education at Environmental Universities (DEEU 2018), held in Kyiv, Ukraine, on October 17–18, 2018.

Keywords: Digital Education at Environmental Universities, DEEU 2018

1. DEEU 2018 in a glance

The V International Conference on *Digital Education in Environmental Universities* (DEEU 2018) was held at the National University of Life and Environmental Sciences (NULES) of Ukraine, Kyiv, Ukraine, on October 17–18, 2018. The founders of the conference were the National University of Life and Environmental Sciences of Ukraine and the Wroclaw Environmental and Life Sciences University; the Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine acted as a co-organizer of DEEU 2018.

DEUU 2018 topics of interest were:

- the key role of digital competence in the knowledge society
- e-learning resources and services at environmental universities
- formation of digital competencies in e-learning
- communication and collaboration with the business
- STEM education and the Internet of Things at environmental universities

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

o.kuzminska@nubip.edu.ua (O. H. Kuzminska); o-glazunova@nubip.edu.ua (O. G. Glazunova); semerikov@gmail.com (S. O. Semerikov)
https://nubip.edu.ua/node/3983 (O. H. Kuzminska); https://nubip.edu.ua/node/14512 (O. G. Glazunova); https://kdpu.edu.ua/semerikov (S. O. Semerikov)
0000-0002-8849-9648 (O. H. Kuzminska); 0000-0002-0136-4936 (O. G. Glazunova); 0000-0003-0789-0272 (S. O. Semerikov)

ACNS Conference Series: Social Sciences and Humanities

Figure 1: DEUU 2018 opening.

This volume represents the proceedings of the DEEU 2018. It comprises 5 contributed papers [1–5] that were carefully peer-reviewed and selected from 48 submissions. Each submission was reviewed by 2 program committee members. The accepted papers present the state-of-the-art overview of successful cases and provides guidelines for future research.

2. DEEU 2018 Committees

2.1. Program Committee

- **Stanislav Nikolayenko**, Rector, D.Sc., Professor, NULES of Ukraine (figure 3)
- **Josef Sovinsky**, Vice-Rector for Students and Education, D.Sc., Professor, Wroclaw Environmental and Life Sciences University
- **Serhii Kvasha**, Vice-Rector for Educational Activities, D.Sc., Professor, NULES of Ukraine
- **Valery Bykov**, D.Sc., professor, Director, Academician of the National Academy of Educational Sciences of Ukraine, Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine (figure 5)
- **Andrii Gurzhii**, D.Sc., Professor, Academician of the National Academy of Educational Sciences of Ukraine
- **Olena Glazunova**, D.Sc., Dean of the Faculty of Information Technology, NULES of Ukraine (figure 4)

Figure 2: DEEU 2018 conference information bundle.

- **Natalia Morze**, D.Sc., Professor, Vice-Rector on Informational Technologies, Borys Grinchenko Kyiv University
- **Arkadiusz Orlovsky**, D.Sc., Professor, Warsaw University of Life Sciences
- **Danuta Parilak**, D.Sc., Professor, Wroclaw Environmental and Life Sciences University
- **Olena Kuzminska**, D.Sc., Professor, Head of the Department of Information and Distance Technology, NULES of Ukraine (figure 6)
- **Eugenia Smirnova-Trybulska**, Doctor Sciences, Professor, University of Silezia
- **Marcin Glowacki**, Ph.D., Wroclaw University of Science and Technology
- **Dmytro Kasatkin**, Ph.D., Associate Professor, Head of the Department of Computer Systems and Networks, NULES of Ukraine

Figure 3: Stanislav Nikolayenko.

Figure 4: Olena G. Glazunova.

- **Krzysztof Piecarchar**, Doctor of Philosophy, Wroclaw Environmental and Life Sciences University

Figure 5: Valerii Yu. Bykov.

Figure 6: Olena H. Kuzminska.

Figure 7: DEUU 2018 committee members (left to right): Olena H. Kuzminska, Viacheslav V. Osadchyi, Svitlana V. Ahadzhanova, Valerii Yu. Bykov, Oleksandra M. Sokolyuk, and Anna V. Iatsyshin.

- **Tomas Valasek**, Ph.D., Czestochowa Polytechnic University
- **Marchen Davobrsky**, Ph.D., President of the Academic Association e-learning, Warsaw School of Economics
- **Yuriy Danko**, Doctor of Economics, Professor, Vice-Rector for Scientific Work, Sumy National Agrarian University
- **Pavel Navitski**, PhD (Cand. of sc.), Associate Professor, Belarusian State Agricultural Academy
- **Anna Stanislavskaya-Mishka**, Krakow University of Economics
- **Maria Wilkins**, Warsaw University of Life Sciences

Figure 8: Joanna Markowska.

2.2. Organizing Committee

- **Vadym Tkachuk**, D.Sc., Vice-Rector for Scientific and Pedagogical Work, International Activities and Development, NULES of Ukraine
- **Tetyana Ishchenko**, Ph.D., Professor, Director, Scientific and Methodological Center "Agro-Education"
- **Volodymyr Naditiko**, Vice-Rector for Scientific Work, Doctor of Technical Sciences, Professor, Tavria State Agrotechnological University
- **Olexandr Novikov**, doctor of sciences, Vice-rector for scientific work, Mykolayiv National Agrarian University
- **Oleksii Tkachenko**, Ph.D., Associate Professor, Deputy dean for scientific work, NULES of Ukraine
- **Anna Iatsyshyn**, Ph.D., Senior Researcher, Deputy Director for Scientific Work, Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine
- **Joanna Markowska**, Ph.D., Center for Distance Learning, Wroclaw Environmental and Life Sciences University (figure 8)
- **Vasyl Shynkaruk**, D.Sc., Professor, Dean of the Humanities and Pedagogical Facult, NULES of Ukraine
- **Svitlana Agadzhanova**, Ph.D., Associate Professor, Head of the Distance Technology Center, Sumy National Agrarian University

- **Natalia Yurchuk**, Ph.D., Associate Professor, Vinnytsia National Agrarian University
- **Jerzy Mishke**, Professor, Independent Consultant, Academic Association e-learning
- **Olesia Viktorova**, D.Sc., Professor, Head of the Department of Social Pedagogy and Information technologies in education, NULES of Ukraine
- **Maxim Mokriyev**, Ph.D., Associate Professor, Head of the Distance Technology Center, NULES of Ukraine
- **Jacek Markowski**, Ph.D., Center for Distance Learning, Wroclaw Environmental and Life Sciences University
- **Viacheslav Shebanin**, Rector, D.Sc., Professor, Mykolayiv National Agrarian University
- **Kateryna Tuzhyk**, Ph.D., Associate professor of the Department of Economic Cybernetics, NULES of Ukraine
- **Tetyana Voloshyna**, Ph.D., Senior Lecturer of the Department of Information and Distance Technology, NULES of Ukraine
- **Monika Brzakola**, Distance Learning Center, Wroclaw Environmental and Life Sciences University

3. DEUU 2018 selected papers overview

E-learning and lifelong learning are considered to be important factors in the knowledge-based society. Synchronous online learning is both a conscious choice of modern universities and a necessity brought about by globalization. The materials of the article "Synchronous learning in online course: a necessity or choice?" [3] by Joanna Markowska and Izabela Kraśniewska are devoted to the issues of justifying the use of synchronous online learning at Wrocław University of Environmental and Life Sciences (WUELS), as well as the selection and expert evaluation of the effectiveness of using ICT to support it. Two main processes have been identified to improve and develop: process of Educating / teaching employees, people interested in raising their qualifications, candidates for studies and Communication of the current and future clients of the university. The stages of the choice of the tools to support the implementation of selected processes are highlighted. To select tools we based on the following criteria: availability, some initial familiarization with the tool, the functions offered, friendly and aesthetic interface, technical support, the possibility of cooperation with the Moodle platform. As a result, to support synchronous online learning in WUELS was selected was a live stream was on YouTube, Skype, an E-science platform and Click Meeting. The effectiveness of the use of the Polish commercial service ClickMeeting has been proven.

The role of universities has been changing over last decades. In the modern society the Humboldtian model of higher education is quite obsolete concept. As a result of competition and globalization, the universities have to be adapted. The question is: how? We have to create The Thrid Generation University that aims to not only learn and research but also to collaborate with industries. Thus IN this collaboration not only university would be a „winner", but also this kind of partnership can be beneficial for the business environment. The article "Win-win – towards the Third Generation. Case study of Wroclaw Environmental and Life Sciences University" [2] by Joanna Markowska, Sylwia Alicja Biały and Martyna Burdzy reports

Figure 9: DEUU 2018 highlights, part 1.

Figure 10: DEUU 2018 highlights, part 2.

Figure 11: DEUU 2018 highlights, part 3.

on a case study of Wrocław University of Environmental and Life Sciences in the moment of transformation. The activity of WUELS will serve as an example – and will be also a basis to analyze the model of knowledge transfer.

The article "Business and university collaboration: how partnership leads to gaining key competences by graduates?" [1] by Sylwia Alicja Biały, Jacek Markowski and Monika Brzakala explores the role of business environment in connection between students and the labour market. Many employers claimed graduates do not posses essential skills that allow them to adaptate effectively in the work environment. It is not caused by new workers' lack of knowledge or their not proper technical skills, but it is rather fault of their lack of drive and work ethic. University is often blamed for mismatch between student's skills and demands of the labour market. As a partner in education reform, the business environment can help students with gaining key competencies and skills.

Digital education can supply the framework to support new learning approaches that engage students, bolster new revenue streams, develop with business collaboration, cut operational costs and preserve highly valued school and university brands and reputations. Effective digital transformation isn't just about technology, though. It requires a willingness to adopt technology in new ways, beyond administrative process. The article actualizes the need to solve the problem mismatch between potential employer expectations and how universities prepare students for the future workforce. The factors that change digital technologies are determined. Approaches to creation next-generation learning environments that effectively prepare students for the future by offering access to the tools they need to prepare for the workplace while also providing a fulfilling learning experience are described in the article "Digital education: risks or benefits with business collaboration" [5] by Kateryna Tuzhyk and Olesia Moroz.

Already today, the spread of the IoT network is gaining momentum. The obvious benefits of connecting IP in the daily life of society are monetized in a significant reduction in costs, and therefore relevant. In addition, the use of such technologies leads to the actualization of certain skills of IoT users, the emergence / development of new competencies, the formation of which, in our opinion, can be done at the first year of higher education or even secondary education. The article gives examples of the use of digital measuring computer systems Einstein, LabDisc, Pasco, Relab, L-micro, FourierEdu – NOVA Link, NOVA 5000, COBRA 4. The advantages of working with digital equipment for teachers and students are identified in the article "Use of digital educational equipment experiment as a current problem of environmental education" [4] by Olga P. Pinchuk and Oleksandra M. Sokolyuk. The ways of IoT development, as well as the implementation of his ideas in the educational process are outlined.

4. DEEU 2018: Conclusion

DEEU 2018 would not have been possible without the support of many people. We would like to thank all the authors who submitted both abstracts and full papers to our conference and thus demonstrated their interest in the research problems within our scope (https://youtu.be/idph86GmuJo, https://youtu.be/BpIBNnqVujs). We are also very grateful to the members of our program committee for providing timely and thorough reviews and being cooperative in doing additional review work. We would like to thank the local organizers of the conference,

and the technical support team for their valuable service and help. Special thanks go to the sponsors of DEEU 2018 whose financial and technical contributions enabled the materialization of this instance of the conference and its sub-events, and the Academy of Cognitive and Natural Sciences (ACNS) for the great opportunity to publish DEEU 2018 proceedings in the *ACNS Conference Series: Social Sciences and Humanities* (https://acnsci.org/cs-ssh/). All these people, their devotion, energy, and efficiency, made our conference a very interesting and effective scientific forum.

References

[1] Biały, S.A., Markowski, J. and Brzakala, M., 2022. Business and university collaboration: how partnership leads to gaining key competences by graduates? *ACNS Conference Series: Social Sciences and Humanities*, 2, p.01004. Available from: https://doi.org/10.55056/cs-ssh/2/01004.

[2] Markowska, J., Biały, S.A. and Burdzy, M., 2022. Win-win – towards the Third Generation. Case study of Wroclaw Environmental and Life Sciences University. *ACNS Conference Series: Social Sciences and Humanities*, 2, p.01003. Available from: https://doi.org/10.55056/cs-ssh/2/01003.

[3] Markowska, J. and Kraśniewska, I., 2022. Synchronous learning in online course: a necessity or choice? *ACNS Conference Series: Social Sciences and Humanities*, 2, p.01002. Available from: https://doi.org/10.55056/cs-ssh/2/01002.

[4] Pinchuk, O.P. and Sokolyuk, O.M., 2022. Use of digital educational equipment experiment as a current problem of environmental education. *ACNS Conference Series: Social Sciences and Humanities*, 2, p.01006. Available from: https://doi.org/10.55056/cs-ssh/2/01006.

[5] Tuzhyk, K. and Moroz, O., 2022. Digital education: risks or benefits with business collaboration. *ACNS Conference Series: Social Sciences and Humanities*, 2, p.01005. Available from: https://doi.org/10.55056/cs-ssh/2/01005.

Synchronous learning in online course: a necessity or choice?

Joanna Markowska[1], *Izabela* Kraśniewska[1]

[1] *Wroclaw Environmental and Life Sciences University, Norwida 25, 50-375 Wrocław, Poland*

Abstract. E-learning and lifelong learning are considered to be important factors in the knowledge-based society. Synchronous online learning is both a conscious choice of modern universities and a necessity brought about by globalization. The materials of this article are devoted to the issues of justifying the use of synchronous online learning at Wrocław University of Environmental and Life Sciences (WUELS), as well as the selection and expert evaluation of the effectiveness of using ICT to support it. Two main processes have been identified to improve and develop: process of Educating / teaching employees, people interested in raising their qualifications, candidates for studies and Communication of the current and future clients of the university. The stages of the choice of the tools to support the implementation of selected processes are highlighted. To select tools we based on the following criteria: availability, some initial familiarization with the tool, the functions offered, friendly and aesthetic interface, technical support, the possibility of cooperation with the Moodle platform. As a result, to support synchronous online learning in WUELS was selected was a live stream was on YouTube, Skype, an E-science platform and Click Meeting. The effectiveness of the use of the Polish commercial service ClickMeeting has been proven.

Keywords: E-learning, synchronous learning, ICT, university

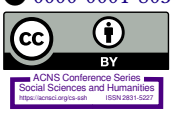
1. Introduction

In the face of the rapidly occurring technological, social and cultural changes, it is possible to put forward a thesis that online synchronous learning is both a conscious choice as well as a necessity that is brought by globalization. Innovation, enhancing competitiveness in relation to the environment, not only in the area of economy but also education, opens for young people the doors to the world, which offers many new opportunities in the field of education, acquisition of the necessary skills sought on the labor market, obtaining interesting employment both on the local market and in various regions of the world. E-learning and lifelong learning are considered to be important factors in the emerging knowledge-based society [5].

The ubiquitous technology brings many benefits, however, if used improperly, it may favor the occurrence of superficiality in learning or influence the appearance of unethical attitudes in the teaching process [12]. Higher education institutions more and more often provide their

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

joanna.markowska@upwr.edu.pl (J. Markowska)
https://bazawiedzy.upwr.edu.pl/info/author/UPWrc624550a026f49ea865d2f15e5c61813/ (J. Markowska);
https://www.linkedin.com/in/izabela-kra%C5%9Bniewska-147018188/ (I. Kraśniewska)
0000-0001-8032-9508 (J. Markowska)



ACNS Conference Series: Social Sciences and Humanities

students with online education, focusing on technologies that eliminate unethical behavior and methods that are aimed at deepening knowledge [3]. Deep learning includes critical thinking, integration of knowledge with the newly acquired and the creation of a new one [1, 2, 13]. Currently, teaching has become a mix of different methods, techniques that use different technologies in any teaching environment, requiring dialogue, cooperation and online activity [17, 18]. Popular and common learning management systems (LMS) are insufficient to store content, manage learning processes in educational institutions [11]. The so-called personal learning environments (PPSs) that create online tools such as blogs, wikis, streaming media, networks and social media, and open access sites are gaining more and more popularity. More often, educational institutions and providers of educational services offer the possibility of synchronous teaching online. However, as emphasized by Hrastinski, Keller and Carlsson [6] synchronous e-learning received much less research attention than in the case of asynchronous teaching, and those who are considering the use and design of synchronous e-learning are in urgent need for guidance on this issue.

In the case of asynchronous and synchronous teaching, the key is a functional approach to communication, which can be defined from the point of view of information theory [19] as information transfer (one function) or broadly based on its many functions such as emotive, cognitive, poetic, phatic, meta-linguistic, and conative [8]. It can be assumed that asynchronous teaching relies heavily on the transmission of information. Synchronous teaching benefits from the possibility of expressing the emotional state, establishing and maintaining contact with the interlocutor, arousing the feelings of the recipient, naming reality. In the context of explaining the need for synchronous and asynchronous teaching, two theories may be helpful: media naturalness hypothesis (MNH) [9] and cognitive model of media choice (MMC) [16], which is used by Hrastinski [5] explaining the diversity of the obtained effects and thus the desirability of using two forms of teaching. Synchronous communication originating from face to face interaction, as more natural, increases the user's motivation, but hinders information processing. Asynchronous communication leaves more time to understand the information and therefore to process it. However, people learning asynchronously require motivation and the ability to process text messages. Hrastinski [5] believes that synchronous communication, as a complement to asynchronous communication, can positively influence the participation of online course participants in online discussions. Similarly Woerner, Orlikowski and Yates [21] indicate that synchronous communication can help in a deeper sense of participation in a conversation. [14] emphasizes the great power of motivating synchronous teaching, which mobilizes the participants of e-courses to keep up with e-learning partners. Hrastinski, Keller and Carlsson [6] suggest including the use of synchronous communication in four important problem situations, which are difficult to solve with asynchronous methods:

1. Supporting strong relations in the group
2. Supporting weak relations in the group
3. Servicing, planning and explaining tasks
4. Creating and supporting social relations

There is no doubt that IT and communication technology improves knowledge sharing, increases the speed of information flow, intensifies learning thanks to the systems supporting

communication and discourse [15]. According to Huang et al. [7] information and communication technology has a significant impact on consumers, industry and government elites. The importance of IT infrastructure and its impact on flexibility, competitive advantage and organizational results are also emphasized by Gheysari et al. [4], Turner and Lankford [20].

2. Case study: Prospects for the development of e-learning in the aspect of university improvement and promotion

Based on the analysis carried out with the use of the strategic score card methodology, it was found that there is a large unused potential for the development of education supported by modern technology based on innovative education methods at Wrocław University of Environmental and Life Sciences (WUELS). Two key processes were selected, both of which the Distance Learning Center participates in. The first process is education both for students and academic teachers – it is an existing process that requires improvement and the process of educating / teaching employees, candidates for studies, people interested in raising their qualifications, candidates for studies, stakeholders – new, in relation to the target group and requiring development. Communication is the second key process – it is a new identified process that in the long-term will play an important role in meeting the needs of the current and future clients of the university. The possibility to improve and develop both processes at WUELS is shown in figure 1.

The challenge is to implement synchronous learning online, it includes several activities such as: the choice of tools, creating interest of academic staff in new opportunities in online teaching, preparation of staff and developing a strategy to support the staff determined to use the new tool as well as obtaining funds.

In the article, the authors present the choice of the tool.

3. Methods

The choice of the tool was made in several stages. **The first one** was to select several tools based on the following two criteria: availability and some initial familiarization with the tool. Both open source and commercial solutions were considered.

What was selected was a live stream was on YouTube, Skype, an E-science platform and Click Meeting. Until now, YouTube has been used to provide open educational resources in the form of videos. Skype is currently being used by us, next to Moodle, to conduct language exams and interviews. Earlier, we used Skype to conduct small, international academic seminars and student workshops. The E-science platform is a proprietary solution created as part of the project "Active Information Platform e-scienceplus.pl" in a consortium of Wrocław's universities. It has a function that allows online synchronous contact for a group of people. The designers intend to enable the creation of research groups, conducting scientific works and managing research groups. ClickMeeting is a Polish commercial service with extensive technical support that has been operating on the world and Polish market for over a dozen years.

The second stage was the evaluation of tools based on internal tests conducted by the employees of the unit. The live broadcast on YouTube, the E-science platform and ClickMeeting

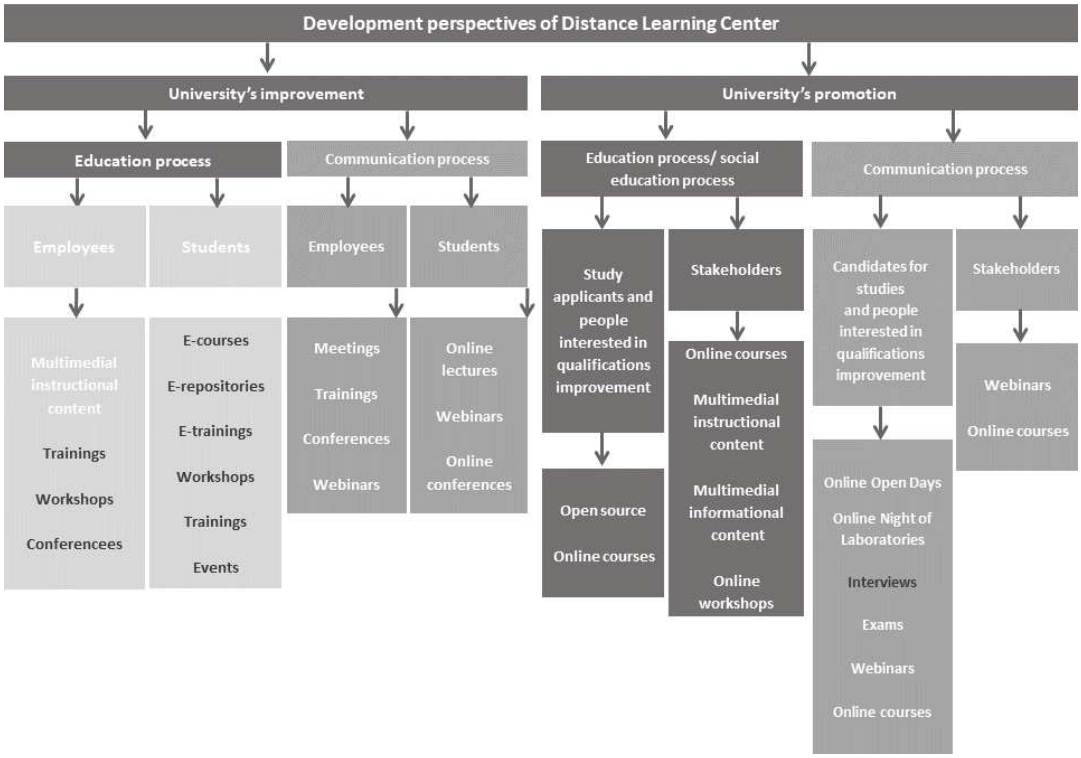


Figure 1: Development perspectives of Distance Learning Center.

were qualified for this stage. The evaluation criteria were: intuitiveness of service, the functions offered, friendly and aesthetic interface, technical support, the possibility of cooperation with the Moodle platform.

When it comes to the intuitive use and aesthetics YouTube does not have a very complicated interface – there are only a few functions on it, but one can regard them as rather little intuitive. The site also has quite an economical color scheme, which we can assessed as neutral. The E-Science platform has many different functions, but its interface is not intuitive, and the website itself looks unfriendly in color. On the other hand, ClickMeeting has a very intuitive interface that most users could use without any instructions. In addition, the site is characterized by an aesthetic color palette.

In terms of the number of features, as already mentioned, YouTube does not have too many of them. Perhaps the functionality is sufficient for commercial purposes, while in the case of didactics of this type, the transmission would not be too practical – although it is possible to interact with listeners, you cannot send files to display, write on a virtual whiteboard, conduct surveys or give voice to listeners. In this form, only an academic lecture would be possible, where, on the other hand, it would be difficult to check the presence of all listeners. Most of the facilities are to be found on the E-Science platform, where you can give voice to the listeners, transfer files and use the virtual whiteboard. The main drawback here, however, is, as already mentioned, the lack of aesthetics, which is a big disadvantage in didactics, because it

will not encourage the students to use it. The teachers themselves may also have a problem with such a low intuitive interface. When it comes to ClickMeeting, in turn, it has a number of different functions – automatic surveys, giving voice to students, writing on a virtual whiteboard, displaying uploaded files – and at the same time all the available functions are very easy to use.

What is the most important in the context of e-learning is its compatibility with the Moodle platform. YouTube and E-Science do not offer such a possibility, but it is possible in the case of ClickMeeting, which makes this platform qualify for the third stage.

The third stage included external tests for academic groups during the actual classes. Each test ended with a survey in which participants assessed the quality of the classes conducted synchronously online. The questionnaire was completed both by the teachers and students.

4. Results and conclusion

The tests of conducting synchronous classes online on the ClickMeeting platform showed that for students this form of teaching is attractive not only because the classes can take place in a site that is most suitable for them, but also because of the use of new technologies, without which it is difficult to function in the 21st century. We should remember that especially for students, the use of technology is very intuitive, because they use it on a daily basis – and therefore transferring teaching in a favorable environment contributes to the enhancement of their attention, and thus – according to neurodidactics – to the improvement of the learning outcomes. For students, synchronous teaching is a new form of learning which stimulates their cognitive curiosity. The ClickMeeting webinar room has many functions that are well used and improve the attractiveness of the classes. A well-designed online lesson with the use of good tools allows one to transfer knowledge in a new way, providing students with new incentives, thanks to which they are more open to the acquired knowledge.

References

[1] Biggs, J., 1999. What the student does: teaching for enhanced learning. *Higher education research & development*, 18(1), pp.57–75. Available from: https://doi.org/10.1080/0729436990180105.

[2] Entwistle, N. and Ramsden, P., 1983. *Understanding student learning*. London: Croom Helm.

[3] Filius, R.M., de Kleijn, R.A., Uijl, S.G., Prins, F.J., van Rijen, H.V. and Grobbee, D.E., 2018. Strengthening dialogic peer feedback aiming for deep learning in SPOCs. *Computers & education*, 125, pp.86–100. Available from: https://doi.org/10.1016/j.compedu.2018.06.004.

[4] Gheysari, H., Rasli, A., Roghanian, P. and Jebur, H., 2012. The role of information technology infrastructure capability (ITIC) in management. *International journal of fundamental psychology and social sciences*, 2(2), pp.36–40.

[5] Hrastinski, S., 2008. The potential of synchronous communication to enhance participation in online discussions: A case study of two e-learning courses. *Information & management*, 45(7), pp.499–506. Available from: https://doi.org/10.1016/j.im.2008.07.005.

[6] Hrastinski, S., Keller, C. and Carlsson, S.A., 2010. Design exemplars for synchronous e-learning: A design theory approach. *Computers & education*, 55(2), pp.652–662. Available from: https://doi.org/10.1016/j.compedu.2010.02.025.

[7] Huang, I., Guo, R., Xie, H. and Wu, Z., 2009. The convergence of information and communication technologies gains momentum. In: S. Dutta and B. Bilbao-Osorio, eds. *The global information technology report 2012: Living in a hyperconnected world.* Geneva: World Economic Forum, pp.35–47. Available from: https://www3.weforum.org/docs/GITR/2012/GITR_Chapter1.2_2012.pdf.

[8] Jakobson, R., 1989. *W poszukiwaniu istoty języka: wybór pism.* Warszawa: Państwowy Instytut Wydawniczy.

[9] Kock, N., 2005. Media richness or media naturalness? The evolution of our biological communication apparatus and its influence on our behavior toward E-communication tools. *IEEE transactions on professional communication*, 48(2), pp.117–130. Available from: https://doi.org/10.1109/TPC.2005.849649.

[10] Kock, N., Verville, J. and Garza, V., 2007. Media naturalness and online learning: Findings supporting both the significant- and no-significant-difference perspectives. *Decision sciences journal of innovative education*, 5(2), pp.333–355. Available from: https://doi.org/10.1111/j.1540-4609.2007.00144.x.

[11] Korhonen, A.M., Ruhalahti, S. and Veermans, M., 2019. The online learning process and scaffolding in student teachers' personal learning environments. *Education and information technologies*, 24(1), pp.755–779. Available from: https://doi.org/10.1007/s10639-018-9793-4.

[12] Markowska, J., Daniel, A., Brząkała, M. and Markowski, J. Postawy – etyka w kursie online. *Eduakcja*, (1 (15)), p.04—13. Available from: http://web.archive.org/web/20200716145835/https://eduakcja.eu/index.php/pl/archiwum/nr-1-15-2018/96-archiwum/nr-1-15-2018/454-postawy-%E2%80%93-etyka-w-kursie-online-2.html.

[13] Marton, F. and Säljö, R., 1997. Approaches to learning. In: F. Marton, D. Hounsell and N.J. Entwistle, eds. *The experience of learning: Implications for teaching and studying in higher education.* 1st ed. Edinburgh: Scottish Academic Press, pp.39–58.

[14] Mason, R., 1998. *Globalising education: Trends and applications.* London: Routledge.

[15] Mitić, S., Nikolić, M., Jankov, J., Vukonjanski, J. and Terek, E., 2017. The impact of information technologies on communication satisfaction and organizational learning in companies in Serbia. *Computers in human behavior*, 76, pp.87–101. Available from: https://doi.org/10.1016/j.chb.2017.07.012.

[16] Robert, L.P. and Dennis, A.R., 2005. Paradox of richness: a cognitive model of media choice. *IEEE transactions on professional communication*, 48(1), pp.10–21. Available from: https://doi.org/10.1109/TPC.2004.843292.

[17] Ruhalahti, S., Korhonen, A.M. and Rasi, P., 2017. Authentic, dialogical knowledge construction: a blended and mobile teacher education programme. *Educational research*, 59(4), pp.373–390. Available from: https://doi.org/10.1080/00131881.2017.1369858.

[18] Ruhalahti, S., Korhonen, A.M. and Ruokamo, H., 2016. The dialogical authentic netlearning activity (DIANA) model for collaborative knowledge construction in MOOC. *The online journal of distance education and e-learning*, 4(2), p.58–67. Available from: https://tojdel.net/journals/tojdel/articles/v04i02/v04i02-07.pdf.

[19] Shannon, C.E. and Weaver, W., 1949. *The mathematical theory of communication.* Urbana:

The University of Illinois Press. Available from: https://pure.mpg.de/rest/items/item_2383164/component/file_2383163/content.

[20] Turner, D.E. and Lankford, W.M., 2005. Information technology infrastructure: A historical perspective of flexibility. *Journal of information technology management*, 16(2), pp.37–47. Available from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.94.6611&rep=rep1&type=pdf.

[21] Woerner, S.L., Orlikowski, W.J. and Yates, J., 2004. The media toolbox: combining media in organizational communication. *Proceedings of the Academy of Management*. Atlanta. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.134.6033&rep=rep1&type=pdf.

Win-win – towards the Third Generation. Case study of Wroclaw Environmental and Life Sciences University

Joanna Markowska[1], *Sylwia Alicja* Biały[1] and *Martyna* Burdzy[1]

[1] *Wroclaw Environmental and Life Sciences University, Norwida 25, 50-375 Wrocław, Poland*

Abstract. The role of universities has been changing over last decades. In the modern society the Humboldtian model of higher education is quite obsolete concept. As a result of competition and globalization, the universities have to be adapted. The question is: how? We have to create The Thrid Generation University that aims to not only learn and research but also to collaborate with industries. Thus IN this collaboration not only university would be a „winner", but also this kind of partnership can be beneficial for the business environment. This paper reports on a case study of Wrocław University of Environmental and Life Sciences in the moment of transformation. The activity of WUELS will serve as an example – and will be also a basis to analyze the model of knowledge transfer.

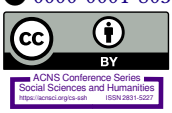
Keywords: third generation university, knowledge transfer, technology transfer, modern education

1. Introduction

Modern universities are changing for the needs of tomorrow. The classic type of the Humboldtian university becomes out of date. The future is to belong to third generation universities, which, in addition to education and research, include a third mission in their field of interest, focusing on the transfer of knowledge, commercialization and innovation [3–5, 8]. The main reason for this change is the fact that Europe has lost its leading position in the world of knowledge and economic development [6]. Various ranking lists prove this; according to the CEBR (Center for Economic and Business Research), a British site that compiles the World Economic LeagueTable ranking, the first three places are occupied by the economies of the USA, China and Japan, and the fourth, fifth and sixth places – Germany, Great Britain and France. The Italian economy was in the eighth place. The best university in the world in Academic Ranking of World Universities (ARWU) for the 10th time proved to be Harvard University – according to the Academic Ranking of World Universities. In the top three of the best universities in the world – apart from Harvard University – there were two other American universities – Stanford University

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

joanna.markowska@upwr.edu.pl (J. Markowska); martyna.burdzy@upwr.edu.pl (M. Burdzy)
https://bazawiedzy.upwr.edu.pl/info/author/UPWrc624550a026f49ea865d2f15e5c61813/ (J. Markowska); https://bazawiedzy.upwr.edu.pl/info/author/UPWr5af00945a38b46b588621aba5d2fd6a5/ (M. Burdzy)
0000-0001-8032-9508 (J. Markowska)



ACNS Conference Series: Social Sciences and Humanities

and the Massachusetts Institute of Technology (MIT). Wissema [7] lists seven important factors that force transformation at universities. These are:

- increase in research costs, which forces universities to look for new sources of financing,
- businesses, especially smaller ones, which stop conducting basic research or cooperation with research centers,
- global competition for students,
- national governments that universities see as incubators for new trade activities,
- scientists working in interdisciplinary teams,
- increase in the number of students, which has resulted in mass education that has diluted the scientific element in academic education,
- formation of specialized research centers, located between academic and industrial research and related to both. These institutions constitute a challenge for academic and industrial research. They conduct part of their research and development activities mainly on the basis of competitive offers.

In Europe, the transformation of universities is indirectly modeled by the Horizon 2020 program. The largest European Union research program so far in the field of research and innovation development, amounting to approximately EUR 80 billion for the period 2014–2020, is intended to support not only basic research but also applied research and innovation. It promotes a multidisciplinary approach and cooperation in the context of sustainable European growth, competitiveness of its industry through scientific excellence and dynamic innovation. The European Commission (EC) has introduced the idea of smart specialization, focusing on universities as key players in economic and cultural growth in modern knowledge society [2].

An additional university mission and new goals to it mean structural and organizational changes, obtaining new sources of financing and developing effective management methods. Wrocław University of Environmental and Life Sciences has been carrying out the transformation of the university towards the third generation university since 2016.

2. Case study: Wrocław University of Environmental and Life Sciences (WUELS)

The introduction of the university in the host circle required the identification of key elements that affect the functioning of the university in a new version. These include management, new sources of financing, staff reorganization, modern didactics, graduates' potential. The change in the way of management was connected with putting on a collegial type of cooperation. This is also understood as the flexibility and integration of the administrative and financial sphere. The main back-up for the new financing is going to be projects, because the ministerial subsidy is not able to ensure the desired development of the university. The philosophy of human capital management is to be Total Quality Management (TQM), i.e. comprehensive management through quality, based on teamwork and the use of reserves inherent in the psyche of each employee for the purpose of enhancing the quality [6]. Didactics should enable students to learn independently and allow the best ones to participate in project. Graduates should not

only be supported financially but also taken advantage of in order to enhance the university development.

Presenting the WUELS case study, we refer to the model proposed by Secundo et al. [5], who divide the "third mission of the university" into three broad categories, each of which is related not only to the appropriate strategy, activities and processes, but also to other categories:

- **Technology transfer and innovation** includes two main processes: intellectual property management and the development of a research and development network.
- **Social involvement**, embedding activity in regional and national as well as international and networking communities.
- **Education and continuing education** focuses on two processes, i.e. attracting talents and incubation, as well as education in the field of entrepreneurial competences

2.1. Co-operation with the economy vs. university vs. scientific development (Technology transfer and innovation)

In the assumption of the third generation university, the economy and social welfare are to be the driving force for the scientific development of the university with mutual benefit. Cooperation with the economy required structural and organizational changes. New units were created aimed at cooperation with businesses, some of the existing units were transformed in the same direction. The multiplicity of departments dedicated to economic cooperation may be surprising, but this results from the criteria for the division of, for example, the type of service carried out, or the type of projects supported. The following structures are associated with it at WUELS.

The Department for Development and Investment Projects supports (application and management) all projects related to investments, e.g. scientific, didactic, administrative, etc. It also finances all other projects acquired by universities. **The Department for Innovation, Implementation and Commercialization** prepares offers for the business environment. The unit offers the possibility of establishing contact with research units or didactics at the university, thanks to which projects can be implemented through cooperation of the business environment with the university. It provides assistance in the application of project applications, takes care of the legal aspect of applications, i.e. oversees the shape of consortium agreements, division of property rights, implementation of patents, use of research results in didactics. It also monitors small commercial contracts run by universities. **The Office of Cooperation and Transfer of Knowledge** supporting the projects from the Horizon 2020 program and projects whose added value will be provided by the Regional Center for Innovative Technologies of Production, Food Processing and Safety, in short Center for Innovative Technologies (CIT). This is the largest investment planned for WUELS in the coming years. Its value is over PLN 94 million, of which PLN 29 million will be covered by the Wrocław University of Environmental and Life Sciences.

2.2. "Lower Silesia. Green Valley of Food and Health" (Social involvement)

One of the largest initiatives of the Wrocław University of Environmental and Life Sciences is the program "Lower Silesia. The Green Valley of Food and Health" prepared by the university in cooperation with the Marshal Office of the Lower Silesian Province introducing the idea of intelligent specialization. The program includes representatives of territorial self-governments,

government administration, as well as entrepreneurs and institutions belonging to the business environment. It is an example of an activity carried out by several entities – university, state and business. The main objective of the entire program is to increase the competitiveness of the regional economy in the area of food and health, improving the quality of life of the inhabitants of Lower Silesia.

2.3. Cooperation with the economy vs. students (Education and continuing education)

Cooperation with the economy should also translate into the sphere of student life. To strengthen this trend within the university certain units have been created that promote student entrepreneurship. They prepare future graduates for developing their career path.

The Academic Incubator of Entrepreneurship supports student entrepreneurship by offering young business people space to carry out business, office and legal services, as well as financial and accounting ones, consulting and training. Thanks to this, students have a chance to appear in the Polish economy at the beginning of their professional career. The Careers Office helps students find a career path suited to their own individual predispositions. It enables establishing contact between employers and students. Entrepreneurs may recruit employees, trainees, apprentices or volunteers from among students and graduates of the University. As part of this unit, optional internships are also implemented.

3. Cooperation with the economy vs. education (Education and continuing education)

Didactics is undoubtedly the first mission of the university, but it cannot be carried out in isolation from other areas. Socio-economic activities result among others in the change of the education program in terms of labor market requirements and in the increase in innovation. Business councils that include local and regional business representatives operate at the faculties. They are a "barometer" of the labor market needs, indicating the needs and desirable directions and profiles of education. An important role is performed by the coordinators for the internship, who are involved in the implementation of compulsory internships at the university looking for interested business entities to accept students for internships. The whole life-long learning program is implemented by the Center for Continuing Education (CKU) through the organization of training courses. It is the Center's responsibility to develop and implement a model for identifying and describing non-formal qualifications supporting formal education and facilitating the confirmation of learning outcomes and adapting to them the offer of educational services. Distance Education Center (CKnO) promotes modern teaching techniques. It implements courses using remote teaching methods and techniques. The courses are used by both students and employees. Scientific activity – through the implementation of projects and research allows for the modernization of the education program guaranteed by the records of commercial contracts concluded by the university. Currently, projects financed by CKU and CKnO, financed from outside, support didactics in the production of open educational materials, and the implementation of modern teaching methods. CKU educational programs

also include potential candidates for studies, an example of which is the "Time for a professional" project. The aim of the initiative is to increase the efficiency of education as well as develop key competences and attitudes necessary for the labor market for both students and teachers of vocational schools and WUELS students participating in the project. The project is part of the idea of the program "Lower Silesia. The Green Valley of Food and Health" – it enables participants to acquire specialist knowledge in the field of food and nutrition, environmental protection, production and processing of agricultural raw materials.

Transformation is a continuous and monitored process. The form of activities, as well as the shape of the organizational structure, its connections are not permanent elements. A solution that will strengthen the university is still being searched for and this search is much likely to become a characteristic feature of third generation universities, and their management will be based on managing change. The university should create a system related to the business environment and the social environment, which will evolve depending on the changing conditions.

4. Methods

The structures described in the case study and their interconnections as well as relations with other units of the university are aimed at increasing the flow of external funds to build educational capital and create scientific and business consortia. Presenting the current WUELS business model based on a case study is the goal of the authors.

The research adopted the heuristic concept and a system approach from the category of system thinking was used [1].

5. Results and conclusion

Research and innovation have a big impact on our lives, way of thinking and work. They contribute to the rapid development of knowledge, and this is an end in itself, especially for universities. They are of key importance when taking on the great challenges faced by the university. Research and innovation can only be ensured by the intellectual capital of the university, which is created by people, management and the social environment, which all together create a system (figure 1).

On the basis of the model, it is appears conspicuous that external funds play a very important role in the development of the university. As a rule, the ministerial subsidy covers only the costs of education. Research and innovations that significantly affect other elements of the system, however, are key elements. The business loop ⟶ scientists ⟶ research is interesting. According to the director of the Innovation, Implementation and Commercialization Department, we can conclude that the model business – university rather than university – business proves more correct at WUELS. In the first model, the initiator of cooperation is a business that knows its needs, has specific goals and is determined to invest its capital in research. These types of relationships are always successful also when it comes to joint fundraising in external funds. The second model has much worse effects and low efficiency. Can this fact be explained by the lack of adequate marketing, insufficient economic, technological and scientific potential, etc.?

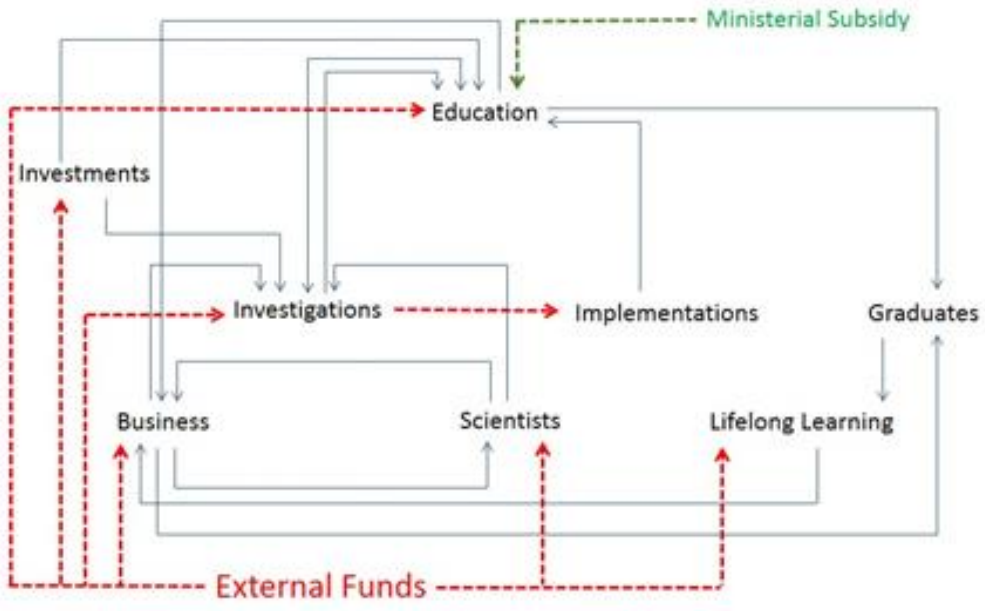


Figure 1: Model of knowledge and technology transfer at WUELS.

These are questions that require deeper analysis. The effectiveness of action in the sphere of linking science with economy is influenced by the speed of decision-making and reliability of performance, which is why the way of the functioning of units created to increase the flow of external funds and support for projects with particular emphasis on the policy of intellectual property protection and subscriptions in contracts regarding the possibility of use of research results in didactics is so important.

Considering the ever-changing reality, in which there are socio-economic and economic changes, and there is increasingly progressive globalization and internationalization, there is no doubt that the role of the university must also be transformed. Universities not only have to follow changes, but also forecast them – and adapt their activities to the desired direction, which in turn will allow to fulfill all the missions of educational institutions.

References

[1] Checkland, P. and Poulter, J., 2010. Soft systems methodology. In: M. Reynolds and S. Holwell, eds. *Systems approaches to managing change: A practical guide.* London: Springer London, pp.191–242. Available from: https://doi.org/10.1007/978-1-84882-809-4_5.

[2] Edwards, J., Elena-Pérez, S. and Hegyi, F.B., eds, 2014. *University-regional partnerships: case studies. Mobilising universities for smart specialisation.* Available from: https://www.researchgate.net/publication/342164821_University_-_Regional_Partnerships_Case_Studies_Mobilising_Universities_for_Smart_Specialisation.

[3] *Lambert review of business-university collaboration*, 2003. (Final report). Available from: https://globalhighered.files.wordpress.com/2009/09/lambert_review_2003.pdf.

[4] Laredo, P., 2007. Revisiting the third mission of universities: Toward a renewed categorization of university activities? *Higher education policy*, 20(4), pp.441–456. Available from: https://doi.org/10.1057/palgrave.hep.8300169.

[5] Secundo, G., Elena Perez, S., Martinaitis, Ž. and Leitner, K.H., 2017. An Intellectual Capital framework to measure universities' third mission activities. *Technological forecasting and social change*, 123, pp.229–239. Available from: https://doi.org/10.1016/j.techfore.2016.12.013.

[6] Trziszka, T., 2016. Uniwersytety znalazły się na pierwszej linii frontu. Etap kolejny: UPWR 3G. *Głos uczelni*, (225), pp.4–9. Available from: https://cutt.ly/VDt78oV.

[7] Wissema, J.G., 2009. *Towards the third generation. managing the university in transition.* Edward Elgar Pub.

[8] Zomer, A. and Benneworth, P., 2011. The rise of the university's third mission. In: J. Enders, H.F. de Boer and D.F. Westerheijden, eds. *Reform of higher education in Europe.* Rotterdam: SensePublishers, pp.81–101. Available from: https://doi.org/10.1007/978-94-6091-555-0_6.

Business and university collaboration: how partnership leads to gaining key competences by graduates?

Sylwia Alicja Biały[1], *Jacek* Markowski[1] and *Monika* Brzakala[1]

[1] *Wroclaw Environmental and Life Sciences University, Norwida 25, 50-375 Wrocław, Poland*

Abstract. This paper explores the role of business environment in connection between students and the labour market. Many employers claimed graduates do not posses essential skills that allow them to adaptate effectively in the work environment. It is not caused by new workers' lack of knowledge or their not proper technical skills, but it is rather fault of their lack of drive and work ethic. University is often blamed for mismatch between student's skills and demands of the labour market. As a partner in education reform, the business environment can help students with gaining key competencies and skills.

Keywords: soft skills, employer, competencies, partnership, university, business

1. Introduction

Employers are becoming more and more demanding towards graduates who enter today's labour market. They demand from graduates skills and competences that should allow them to adapt effectively in the work environment. What we can we can observe in many countries is that employers are not satisfied with the skills graduates possess. It is said that there are too many graduates and what is more, most of them are not prepared for the world of work [12]. This tendency does not occur only in the European labor market. In one of the biggest American concerns, the Boeing Company, employers admit that they have to spend 13 weeks for training new employees for the jobs that used to require only half of this time. The reason is that the graduates did not have proper skills to operate materials effectively [9].

If we quote opinion of Mckinsey Global Institute, that about 60% of occupations have at least 30% of their activities that are automatable, we will come to the conclusion that students should acquire competences that cannot be replaced by technologies. Thus it is essential that we should create education which enables acquisition of relevant skills, including technical and vocational skills. The purpose of education today should be concentrated on better compatibility with the needs of labour markets, education and also training systems [1]. This purpose can be achieved through collaboration between university and business.

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

jacek.markowski@upwr.edu.pl (J. Markowski); monika.brzakala@upwr.edu.pl (M. Brzakala)
https://bazawiedzy.upwr.edu.pl/info/author/UPWr5cf3283bdc3b4b9d8941f7334b112a9a/ (J. Markowski); https://bazawiedzy.upwr.edu.pl/info/author/UPWrd5fd635941eb49698fb01778737b97b9/ (M. Brzakala)

ACNS Conference Series: Social Sciences and Humanities

The most valuable sources of information about the needs of the labour market are the employers. They are practitioners, thus they can reflect upon this issue from a recent and updated point of view. In this context we are more focused on the competences, skills and graduates' way of thinking. Knowledge is also important, but every job requires some prior training.

The aim of this paper is to show that business can help universities in connecting students with the world of work [9]. We will focus on competences that are necessary in the modern workplace and we will try to prove that collaboration between university and business can help students acquire these skills.

2. Key competences in the today's workplace

In 2017, the level of unemployment among young people aged 20–34 who neither undertook professional activity nor studied in the European Union was 17.2%. Figure 1 shows the level of unemployment among young adults broken down by individual EU countries.

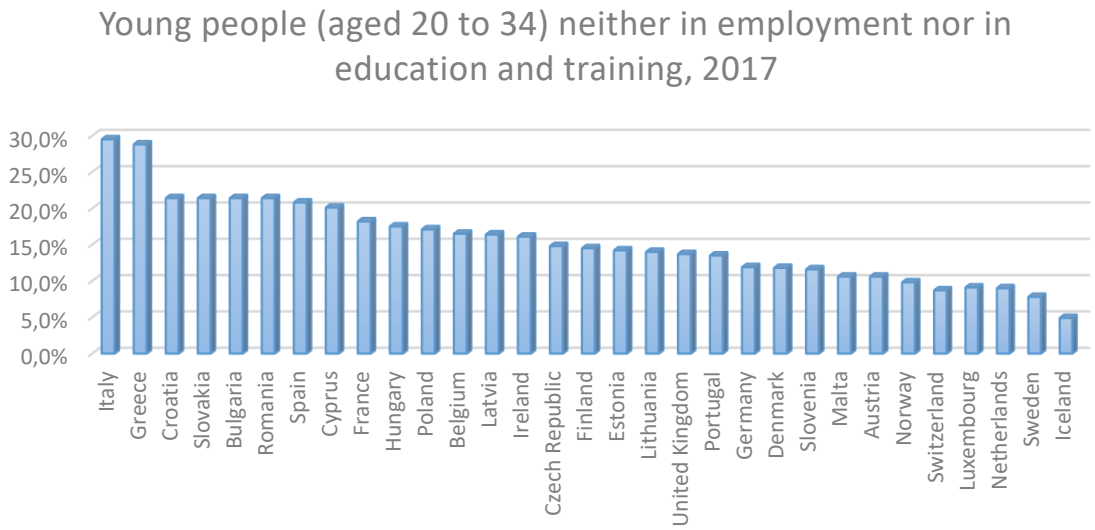


Figure 1: Young people (aged 20 to 34) neither in employment nor in education or training, 2017 (based on statics: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Statistics_on_young_people_neither_in_employment_nor_in_education_or_training&oldid=397040).

From the chart we can see that in Italy and Greece the level of unemployment among young people is quite high – 29.5% and 28.8%, respectively. Then in Croatia, Slovakia, Bulgaria and Romania the level of inactivity among students is also quite high – it amounts to 21.4%. The group includes people who are professionally inactive and have not studied for at least four weeks during the survey. The potential cause of quite a large percentage of NEET in Europe, among others ones, can be lack of appropriate skills to work in a given area.

In the recent years there is a growing interest in the problem of how students' skills and competences fit today's labour market.

Employers do not only require basic skills from employees. Their expectations are higher. Some of the skills can be learned during work and most companies provide adequate training. However, some of basic competences are required from the beginning [4]. Employability" of graduates depends on various factors – and „employability" is not only regarded as simply „getting a job". More important is to have skills that allow an employee to stay in the job and strive to get a promotion [2]. What skills are the most required? The Federal Government in the Australia has indentified a list of skills that increase probability of achieving a success in the work life. Although this list is related to another continent, we can see that these skills are universal for most of the workplaces [2]:

1. Communication
2. Teamwork
3. Problem solving
4. Initiative and enterprise
5. Planning and organising
6. Self-management
7. Learning
8. Technology

A good balance between these skills – based on other circumstances such as position, profile of industry etc. – provides a good worker. They are essential for various work environments. As we can see, not all of the skills are connected with technical competences. Communication, teamwork, problem solving or planning and organizing are more associated with „soft skills competences". It is noticeable that in the recent years employers are also more focused on this area. We do not know if the forecast about automating most of the activities in the workplace is too wishful or maybe just accurate, but the fact is that employers are more and more appreciative of skills that are not connected with science or IT. Still, they are very important but according to the report by Todd [11] proper judgment and decision making or critical thinking are more significant. Even the best computer cannot replace these skills.

Why soft skills are so important? Because they cannot be replaced and they influence relations among employees, co-workers, clients. Especially when we work with clients – in this context „clients" might be a house buyer as well as a student – we must have the ability to communicate effectively with various people. Also we have to understand clients' need and reasoning, and be able to make a good self-presentation. Employers from UK emphasized in the survey the importance of soft skill competences. Nearly 100% of them consider „social and interpersonal skills" and „verbal communication skills" essential for workplace. At the same time they admit that most of these skills are learnt within the family context (61%) or at school (55%) – only 33% think that they can be learnt in college. Undoubtedly these skills are part of lifelong learning and they depend on various factors, but higher education can help with acquiring or developing them.

According to employers many of graduates do not possess essential skills. Based on „Diagnoza stanu Szkolnictwa Wyższego" (*Diagnosis of the State of Higher University Education*) prepared by Ernst & Young Business Advisory study programs do not match the needs of today's labour market and do not equip students with the necessary, universal (transitive) skills and do not

teach appropriate work culture to them. Such opinions are also to be found in other countries. American employers, for instance, claim that finding a suitable job applicant is difficult. It is not caused by candidates' lack of knowledge or their not proper technical skills, but it is rather due to their lack of drive and work ethic. In the Australia employers were often disappointed with such skills as teamwork, leadership, verbal communication ability and interpersonal skills of graduates [2]. In the UK the government blames universities for this mismatch. It is hard to discuss advisability of this statement, because obviously not only higher education is responsible for acquiring these competences. Still, university can be the institution which supports students in the developing the above mentioned skills, especially in collaboration with other partners. We can repeat after The Education Task Force of the Illinois Business Round Table that *The business community, in partnership with political and education leaders, must play a significant leadership role in education reform* [9]. According to many authors partnership between higher education institutions and industry is a good method for insertion in the labor market, for the student's professional skills and competences development [10].

3. University-business collaboration

There are two paradigms of thought about the role of the university and higher education. The first one is based on a more practical approach, which includes global and supranational recommendations (including the World Bank, OECD and European Commission) along with the directions of higher education reforms supported by the ideas of New Public Management. On the other hand, we have a more traditional paradigm, according to which the academic community is a value in itself that needs to be cultivated – and the academic environment itself is characterized by elitism [5]. In this text we show that only the first of these paradigms can contribute to the development of the university and will allow for more practical education, preparing students for future professional life – and therefore it is necessary to follow the path of reforms. In the past education might not have a link with the surroundings. Why? Because most of the students came from wealthy families – they did not have to gain competences essential for the labour market. When somebody was an excellent student, they could start their own academic career [8]. Now the situation has changed. Students have to be prepared for the labour market – and one of the university's mission is to train future workers. Obviously, not only university is responsible for that.

Relations with the environment are according to the "Diagnosis of the State of Higher Education" the third mission of Polish universities and one of the key activities aimed at reforming higher education. One of the issues in this area is cooperation between universities and employers in order to adapt education programs to the needs of the modern labor market. It should be noted that this action will be beneficial both from the point of view of the university and students as well as employers themselves. Thanks to such cooperation, the university has the opportunity to improve the education program and teach students in accordance with the needs of the labor market, as well as in the field of external activities – to promote the institution itself and to gain additional funds. On the other hand, the business environment has the chance to recruit candidates equipped with the necessary skills, as well as get an opportunity for additional education for their employees (lifelong learning) and raise their qualifications,

and as a result – higher employee productivity. Cooperation builds a positive image of both entities.

The model of collaboration between university and business is shown at figure 2.

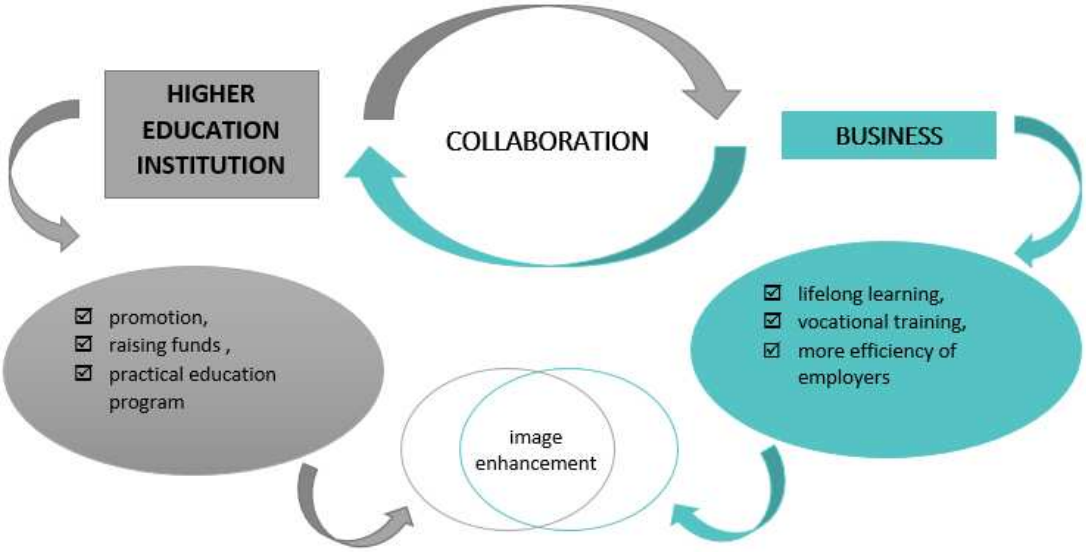


Figure 2: Model of U-B collaboration.

The third element is the satisfaction of the students themselves, who in the studies carried out in the EU27 in 2007 almost unanimously (97%) stated that the most important thing for them was that the universities should provide them with the skills and knowledge necessary in the labor market. In addition, the level of qualifications of students is also of interest to the business environment. A graduate equipped with the necessary skills is at the same time a good employee. Therefore, we have three groups of beneficiaries: university, business and students. The model of this collaboration is shown at figure 3.

Benefits from this collaboration are clarified. Now we can consider how university can collaborate with business. In the State of European UBC Report there have been pointed out 8 possible types of such cooperation [3]:

1. Collaboration in R&D (Research and Development) – consists in R&D activities, contract research, R&D consulting, collaboration in innovation, joint publications with company scientists/researches and also joint supervision of Bachelor, Master or PhD theses or projects in cooperation with business environment.
2. Mobility of academics – includes temporary movement of professors, researchers from HEIs (Higher Education Institutions) to business; also employees, managers and researches can transfer from business to HEIs.
3. Mobility of students – students temporarily move from HEIs to business (internships).
4. Commercialization of R&D results – includes the commercialization of R&D results.
5. Curriculum development & delivery – includes mutual development of courses, modules,

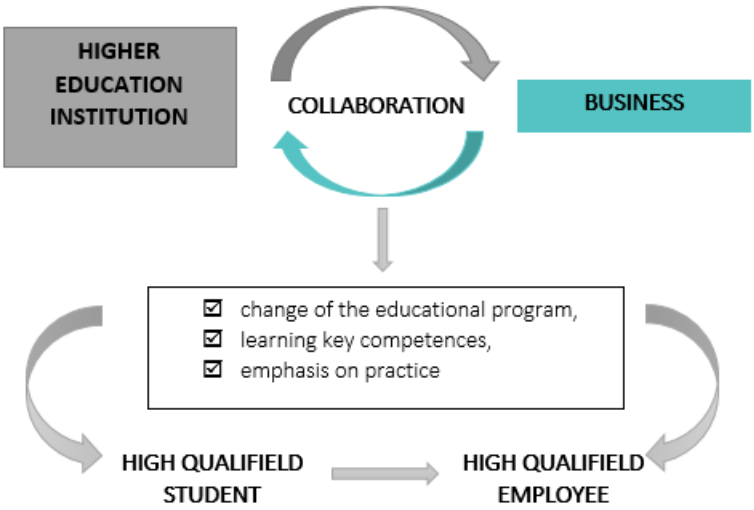


Figure 3: Model of U-B-S collaboration.

majors or minors, planned experiences as well as guest lectures by delegates from both private and public organizations with undergraduate, graduate or PhD programs.

6. Lifelong learning – is related to adult education, permanent and/or continuing education involving the acquisition of skills, competencies, knowledge attitudes and behaviours by HEIs to people working in organization.
7. Entrepreneurship – includes HEIs action towards the creation of the new ventures or developing entrepreneurial mind-sets in collaboration with business.
8. Governance – considers academics who are involved in firm decision-making or sitting in company boards and also having business leaders involved in HEI decision-making or play the role of a faculty manager.

In this paper we are interested especially in Curriculum development & delivery, lifelong learning and entrepreneurship. However, we would like to emphasize that every aspect of this collaboration is important. According to the results of the research of „The State of University-Business Cooperation in Poland", it was proved that collaboration between university and business in Poland is lower than in other European countries.

There are different ways of collaborating with business. At the highest level in terms of structure, we will talk about cooperation between the entire university and a given company. All the above examples are based on this type of cooperation. Then, cooperation between non- departmental university units and enterprises can be distinguished – for example, the implementation of a specific project. Finally, one can distinguish designing single courses or classes that will be adapted to the needs of the labor market. We can involve entrepreneurs here, who also have a general education, to give a lecture or conduct the entire course during a semester. However, even the participation of representatives of this environment is not necessary in each case – we can use teaching methods that will meet the needs of the labor market without direct participation of the company. An example of such a method will be

presented later in this text. The structural ways of collaborating between HEI and business is shown at figure 4.

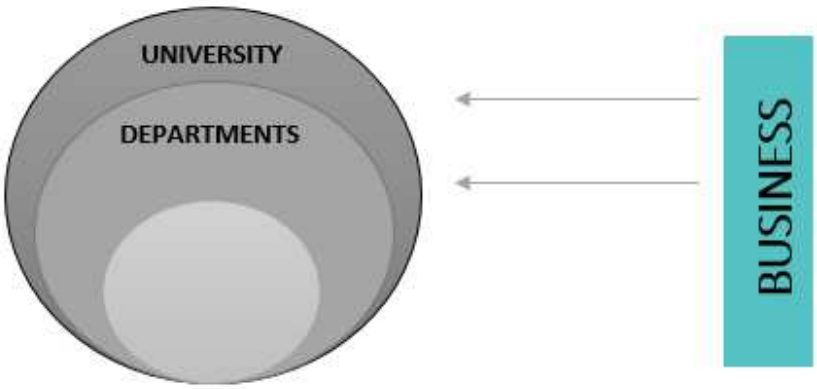


Figure 4: The model of collaborating between HEI and business.

We can also design courses for employees. The best form to design courses in harmony with work environment is e-learning and modern technology. The use of technology and multimedia to assist in education is quite an old concept, but it is still expanding [7]. Technology skills were mentioned in the previous list and it is not negotiable that they are a very important competence. Additionally, e-learning as a common form of learning in higher education (blended learning) and in business environment can be beneficial in this collaboration. Especially in the aspect of lifelong learning of employees it seems to be the best solution. We have to remember that business is a specific area – and time is one of the most valuable things for this environment. And how to save time and learn? By doing it in any time in any place – and that is that what e-learning can provide us with. There are plenty of e-learning courses, but the guarantee of quality is something that university offers.

Collaboration between business and university takes various forms. However, regardless of the form academic education could not occur in isolation from the surroundings. Only including the needs of today's labour market will allow us to create an educational program that teaches essential skills and competences. In spite of this university does not become less elitist through collaboration with industries. This kind of collaboration can increase the educational potential of an institution and have a good influence on university's image, promotion and funds. Business environment also benefits from this kind of partnership. Better students are better graduates – and in the near future better employees. The main beneficiaries of this collaboration are students. They have a chance to gain key competencies and fit in today's labour market – which is not always easy.

References

[1] Business Europe, 2014. Education and training 2020 stocktaking. Available from: http://web.archive.org/web/20180626081806/http://ec.europa.eu/assets/eac/

education/policy/strategic-framework/doc/et2020-businesseurope_stocktaking_en.pdf.

[2] Carroll, D., ed., 2014. *Skills for academic and career success*, Always learning. Pearson Australia.

[3] Davey, T., Galán-Muros, V., Meerman, A. and Kusio, T., 2013. The State of University-Business Cooperation in Poland. Available from: http://www.ub-cooperation.eu/pdf/poland.pdf.

[4] Henrich, J., 2016. Competency-based education: The employers' perspective of higher education. *The journal of competency-based education*, 1(3), pp.122–129. Available from: https://doi.org/10.1002/cbe2.1023.

[5] Kwiek, M., 2017. Wprowadzenie: Reforma szkolnictwa wyższego w Polsce i jej wyzwania. Jak stopniowa dehermetyzacja systemu prowadzi do jego stratyfikacji. *Nauka I Szkolnictwo Wyższe*, (2(50)), pp.9–38. Available from: https://doi.org/10.14746/nisw.2017.2.0.

[6] Markowska, J., Markowski, J., Majchrzak, A., Daniel, A., Markowska, U. and Dzieżyc, H., 2015. Teamwork in the online course – the study based on the questionnaire. *EduAkcja. Magazyn Edukacji Elektronicznej*, (2 (10)), pp.4–13.

[7] Phelan, J.E., 2015. The Use of E-Learning in Social Work Education. *Social work*, 60(3), pp.257–264. Available from: https://doi.org/10.1093/sw/swv010.

[8] Pujol-Jover, M., Riera-Prunera, C. and Abio, G., 2015. Competences acquisition of university students: Do they match job market's needs? *Intangible capital*, 11(4), pp.612–626. Available from: https://doi.org/10.3926/ic.625.

[9] Stephens, R. and Richey, M., 2013. A business view on U.S. education. *Science*, 340(6130), pp.313–314. Available from: http://www.jstor.org/stable/41942224.

[10] Stăiculescu, C., Richiţeanu-Năstase, E.R. and Dobrea, R.C., 2015. The university and the business environment - partnership for education. *Procedia - social and behavioral sciences*, 180, pp.211–218. The 6th International Conference Edu World 2014 "Education Facing Contemporary World Issues", 7th - 9th November 2014. Available from: https://doi.org/10.1016/j.sbspro.2015.02.107.

[11] Todd, B., 2017. These skills make you most employable. Coding isn't one – can that be right? Available from: https://80000hours.org/articles/skills-most-employable/.

[12] Universities UK, 2015. Supply and demand for higher-level skills. Available from: https://www.timeshighereducation.com/sites/default/files/breaking_news_files/supply_and_demand_for_higher_level_skills.pdf.

Digital education: risks or benefits with business collaboration

Kateryna Tuzhyk[1], *Olesia* Moroz[1]

[1]*National University of Life and Environmental Sciences of Ukraine, 15 Heroiv Oborony Str., Kyiv, 03041, Ukraine*

Abstract. Digital education can supply the framework to support new learning approaches that engage students, bolster new revenue streams, develop with business collaboration, cut operational costs and preserve highly valued school and university brands and reputations. Effective digital transformation isn't just about technology, though. It requires a willingness to adopt technology in new ways, beyond administrative process. The article actualizes the need to solve the problem mismatch between potential employer expectations and how universities prepare students for the future workforce. The factors that change digital technologies are determined. Approaches to creation next-generation learning environments that effectively prepare students for the future by offering access to the tools they need to prepare for the workplace while also providing a fulfilling learning experience are described.

Keywords: digital education, collaboration of universities and business, learning environment

1. Introduction

Technology continually breaches almost every area of our lives and the high education sector is no exception. Most students have grown up online and will expect the same levels of technology in their learning environments as in their day-to-day lives [5]. Students of 21 century want always-on access to the resources, wherever they are on or off campus, for a deeper and more flexible learning experience [5]. In fact, the nature of education target audience means that it must adapt to accommodate this audience expectations.

To show the ever-increasing level of the Information and communication technology (ICT) development its service exports (computer and communications services and information services) is represented on figure 1 [10].

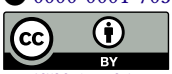
In parallel with the benefits of e-learning at universities, there are fears of scientists that online access of lectures reduces student attendance. But the results of an experiment of scientists from Queen's University Belfast [2], showed that this did not have a negative impact on student's attendance, and that the students instead used personnel to strengthen traditional training.

The experiment covered 80 students who were interviewed before the start of the course, 27 percent of the respondents said that if the video was available, they would no longer consider attending lectures as an integral part of their training. But the analysis of attendance showed

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

kateryna_t@nubip.edu.ua (K. Tuzhyk); morozolesiaua@gmail.com (O. Moroz)

0000-0001-7057-3400 (K. Tuzhyk)



ACNS Conference Series: Social Sciences and Humanities

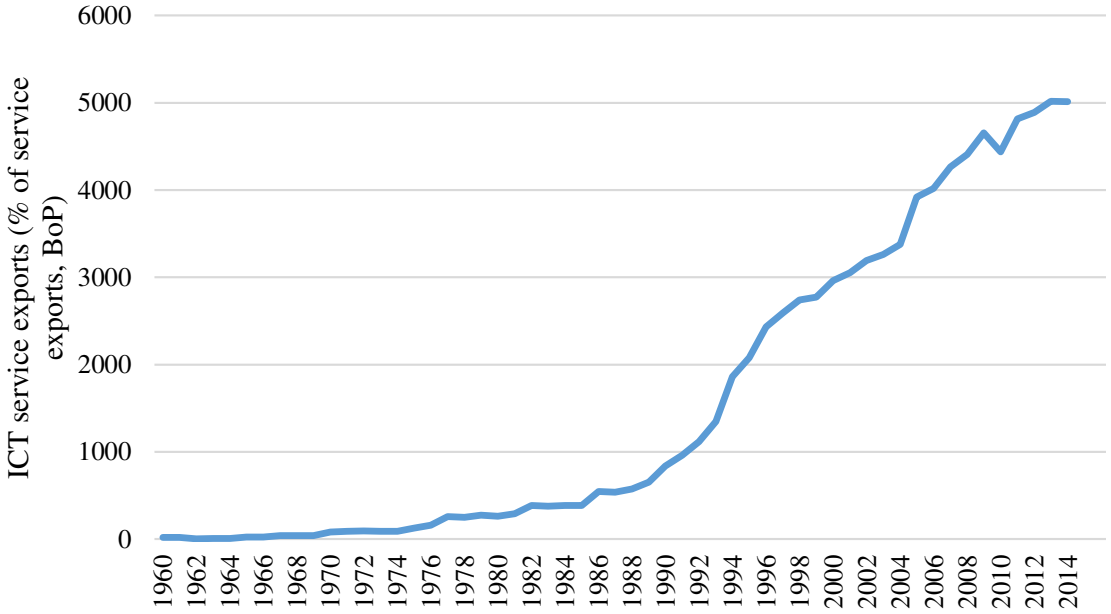


Figure 1: World ICT service exports (% of service exports, BoP) [10].

that the lectures that were posted on the Internet had a higher average attendance rate of 86 percent compared to the rate where the main points were not posted on the Internet 81 percent. In addition, in a survey conducted after the end of the course, 96 percent of the students said that the availability of staff did not affect their attendance. What more, researchers found that the videos that had tended to prove most popular were those that were linked to assessments. In the post-course survey, 98 per cent of students said that revision in preparation for an exam was a primary reason for viewing a video [3].

Creating a digital learning environment is not just about offering convenience and familiarity to students, however. Employers want graduates who are adept at using ICT for different tasks on their workplace. This mismatch between potential employer expectations and how universities prepare students for the future workforce has been well documented in academic studies, and continues to be an issue [5].

2. The results and discussion

With the right technology platform, solutions and industry partners, universities are starting to create next-generation learning environments that effectively prepare students for the future by offering access to the tools they need to prepare for the workplace while also providing a fulfilling learning experience.

With more details the study about new digital technologies impact to education industries was examined at length in the research “Digital Vortex How Digital Disruption Is Redefining Industries”, developed with IMD [5]. There were highlights three main things that digital

technology is changing [7]:

- flexibility of learning, which means being able to alter the place, the pace and the mode of learning;
- fundamental change in the way that learners are able to gain knowledge, skills and competencies through the use of technology, which is going to be useful for their future employment in our increasingly digital world;
- fundamental change in the way that learners are able to interact with other individuals, both their peers and educators, from all around the world as a result of digital technology.

The collaboration of universities and business is one of the important issue of ICT's role in education that presented in figure 2. One of the most important issue in universities and business collaboration is that young people can't find jobs and employers can't find people with the right entry-level skills [1]. How to solve this problem?

ICT in logistic	**ICT in the learning process**	**ICT in the field of study**	**Impact on business model**
• Administrative processes • ICT in facilities and lecture rooms • Any device	• Blended/Online • Learning analitics • Automated feedback • Self-control for learning progress	• Digitization Sectoral ICT developments • Required skills upon graduation • Keeping up to date as alumni	• New target groups (lifelong learners) • Collaboration with business • Certification • More flexibility (e.g. credits for MOOCs)

Figure 2: The different roles of ICT in education at universities [9].

The McKinsey & Company study [1] highlights two solutions to prepare work-ready graduates. First, employers can help design curricula and offer their employees as faculty while education providers can have students spend time on a job site and assist with job placement [8]. *For example, the INJAZ Junior Achievement programme in the Middle East aims to provide business skills and financial literacy to students in Egypt, Jordan, Lebanon, Morocco, Saudi Arabia and the united Arab Emirates through a mixture of classroom and extracurricular activities* [4]. Second, graduates who has found the job don't already have additional time to come back to traditional class for get new knowledge that may be required by employer. And there is most transformative solutions – universities may offers advanced programs to provide in-depth training that can help graduates qualify for highly specialized dealership positions requiring brand-specific knowledge using the online learning platform [8]. Such collaborations help solve the skills gap at a sector level by splitting costs among multiple stakeholders (educators, employers and trainees) [1]. *For example The Cisco Digital Education Platform that has transformed more than 14,250 school districts*

and educational institutions and 9,800 colleges and universities in 127 countries. With their partners, they help colleges and universities create a completely integrated digital environment [6]. Another one of the best practice in universities and business collaboration using ICT is Universal Technical Institute (UTI) that embraces this model through industry partnerships with manufacturers of more than 30 leading brands (Ford, GM, Mercedes-Benz, Toyota, Peterbilt, NASCAR and others) to create some of the most innovative and sophisticated education programs in the automotive, diesel, motorcycle, marine and motorsports industries. UTI's original equipment manufacturer partners invest millions of dollars in the development of curriculum, design of labs, and supplying of vehicles and equipment for the students' real world learning experience. Educators closely collaborate with manufacturers on curriculum development and training program and business representatives meet with educators, review curricula and recommend changes to align learning with industry demand [8].

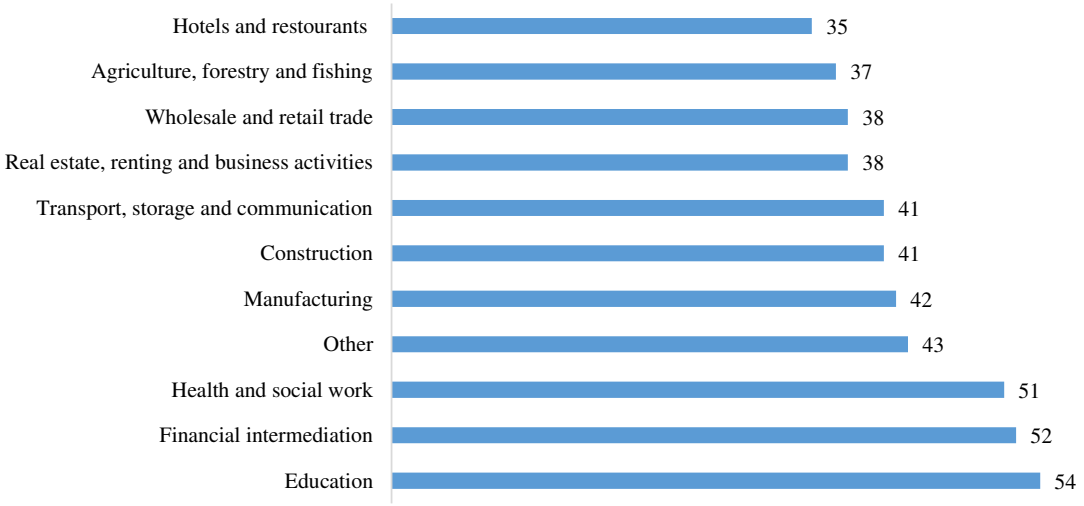


Figure 3: Employee preparedness be sector, % (% of employer respondents who state that new-hire employees were prepared; minimum 100 respondents per sector) [1].

3. Conclusions and prospects for further research

Digital education can supply the framework to support new learning approaches that engage students, bolster new revenue streams, develop with business collaboration, cut operational costs and preserve highly valued school and university brands and reputations. For example, the ability to connect with outside experts or even lecturers with other schools and universities – both nationally and internationally – could increase the number of courses offered and attract more students [5].

Effective digital transformation isn't just about technology, though. It requires a willingness to adopt technology in new ways, beyond administrative process. It must be continual and evolutionary in order to enhance teaching and learning, support business processes and improve

efficiency. One of the risks of misunderstanding is that we buy into the idea that digital technology is magical pixie dust that will fix all the problems. But digital is the end point of the chain. In fact, the real change lies in the enablers to creating a great digital product or digital course – things like changing the way that course teams work, putting real structure into learning designs, course objectives and learning outcomes. That's the work that has the profound effect, not the fact that it's digital [7].

In most countries governments are not at the steering wheel of digitization, but they can certainly set the framework conditions. That's why universities need innovators and experts from government, business, research and education to work together to develop and implement new approaches for educating and supporting teachers so that they are well prepared and equipped to face the digitisation challenges [4].

The latest initiative, ICT for Everyone: A Digital Agenda for Sweden in 2011 reiterated that "Everyone of working age must have good digital skills to be employable or be able to start up and run businesses" [4].

References

[1] Barton, D., Farrell, D. and Mourshed, M., 2013. Education to employment: Designing a system that works. Available from: https://www.mckinsey.com/industries/education/our-insights/education-to-employment-designing-a-system-that-works.

[2] King's College London, 2018. Available from: https://www.timeshighereducation.com/world-university-rankings/kings-college-london.

[3] McKie, A., 2018. Twice as many students skip all lectures when videos available. Available from: https://www.timeshighereducation.com/news/twice-many-students-skip-all-lectures-when-videos-available.

[4] OECD, 2016. *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills.* Paris: OECD Publishing. Available from: https://doi.org/10.1787/9789264265097-en.

[5] Patton, R., 2018. Digital evolution: a new approach to learning and teaching in higher education. Available from: https://www.timeshighereducation.com/blog/digital-evolution-new-approach-learning-and-teaching-higher-education#su.

[6] The Cisco Digital Education Platform A Comprehensive, One-of-a-Kind Approach that is Changing Everything, 2016. Available from: http://web.archive.org/web/20200804005201/https://www.cisco.com/c/dam/en/us/solutions/collateral/industry-solutions/education/digital-learning-higher-screen.pdf.

[7] Thomas, A. and Morris, N., 2017. Is digital technology changing learning and teaching? The big debate from Digifest 2017. Available from: https://www.webarchive.org.uk/wayback/archive/20170701114820/https://www.jisc.ac.uk/news/is-digital-technology-changing-learning-and-teaching-15-mar-2017.

[8] Tkaczyk, J.M., 2016. Collaboration between Education and Industry: Key to Workplace Readiness. Available from: http://web.archive.org/web/20200920041025/https://www.pearsoned.com/collaboration-between-education-and-industry-key-to-workplace-readiness/.

[9] VSNU, 2017. Digitisation in academic education. Our agenda for a future-proof range of degree programmes. Available from: https://www.vsnu.nl/files/documenten/VSNU%20Digitisation%20in%20academic%20education.pdf.

[10] World Bank Group, 2018. ICT service exports (% of service exports, BoP). Available from: https://data.worldbank.org/indicator/BX.GSR.CCIS.ZS.

Use of digital educational equipment experiment as a current problem of environmental education

Olga P. Pinchuk[1], *Oleksandra M.* Sokolyuk[1]

[1]*Institute for Digitalisation of Education of the NAES of Ukraine, 9 M. Berlynskoho Str., Kyiv, 04060, Ukraine*

Abstract. Already today, the spread of the IoT network is gaining momentum. The obvious benefits of connecting IP in the daily life of society are monetized in a significant reduction in costs, and therefore relevant. In addition, the use of such technologies leads to the actualization of certain skills of IoT users, the emergence / development of new competencies, the formation of which, in our opinion, can be done at the first year of higher education or even secondary education. The article gives examples of the use of digital measuring computer systems Einstein, LabDisc, Pasco, Relab, L-micro, FourierEdu – NOVA Link, NOVA 5000, COBRA 4. The advantages of working with digital equipment for teachers and students are identified. The ways of IoT development, as well as the implementation of his ideas in the educational process are outlined.

Keywords: IoT, digital measuring computer systems, environmental education

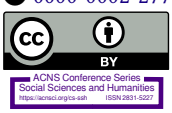
According to [4, 13, 14], the need for expert analysts in 2020 will be 1.5 million people, the process automation software market will reach $10 billion, the share of B2B services (electronic business model Business-to-Business) – 70%, the number of connections using mobile devices in the world by 2025 will grow to 75 billion. Under these conditions, the coverage of the Internet of Things (IoT) will rapidly expand, although today the distribution and use of IoT are considered modern trends [1]. In Ukraine, there are projects at the national level aimed at the development of this network [2, 7, 12].

Application examples of IoT sensors cover almost all spheres of society: intelligent measurements of housing and communal services (meters for electricity, gas, water, household waste, heating), smart home, sensors in the automotive industry, sensors in medicine, sensors in the field of health and beauty, location without GPS, smart street lighting, smart security, agricultural instruments, environmental sensors [3, 15, 16].

The obvious benefits of IP connectivity in everyday life are monetized into significant cost savings. Thus, the effect of the introduction of IoT is expected in the automotive industry (data exchange between vehicle nodes, remote software updates, unmanned vehicles), transport (monitoring of moving objects, smart parking, smart lighting), healthcare (online patient monitoring, microchip technology), security environment (monitoring air quality), agriculture (processes of fertilization, distribution of seed sowing, reducing the consumption of fuels and lubricants,

DEEU 2018: V International Conference on Digital Education at Environmental Universities, October 17–18, 2018, Kyiv, Ukraine

opinchuk100@gmail.com (O. P. Pinchuk); sokolyuk62@gmail.com (O. M. Sokolyuk)
https://iitlt.gov.ua/eng/structure/detail.php?ID=442 (O. P. Pinchuk);
https://iitlt.gov.ua/eng/structure/detail.php?ID=1139 (O. M. Sokolyuk)
0000-0002-2770-0838 (O. P. Pinchuk); 0000-0002-5963-760X (O. M. Sokolyuk)



ACNS Conference Series: Social Sciences and Humanities

monitoring natural parameters) and many other areas and industries.

LPWAN (low-power wide-area network) is a long-distance wireless technology for transmitting small data over long distances, designed for distributed telemetry networks, "machine-to-machine interaction" and the Internet of Things [10]. LPWAN is one of the wireless technologies that provides a data collection environment for various equipment: sensors, meters and sensors. The advantages of LPWAN are long range, high permeability, low power consumption, low cost, high capacity, high scalability, security, geolocation.

Along with this, the use of such technologies entails the *actualization of certain skills of IoT users*, the emergence / development of new competencies, the formation of which, in our opinion, can be carried out both at the level of the first years of higher education institutions and senior classes of K-12 schools [9].

The current curricula in physics (we consider as an example, but are not limited to) define the subject content of the key competencies of students; teachers (teams of researchers, methodologists) select educational resources for their formation [11]. For example, the components of digital competence include the ability to use modern digital devices as a means of measurement; work with digital equipment of virtual laboratories; use computer models of physical processes and phenomena [5, 8]. Electronic educational and information resources, digital laboratories, measuring complexes are determined as resources for the formation of the allocated skills (we consider as an example) in accordance with the capabilities of the educational institution and the readiness of teachers.

Various modern digital tools make it possible to carry out a teaching experiment, modeling, emulation without requiring additional special equipment. These tools include virtual and digital laboratories, digital measuring computer systems. Digital measuring computer complexes are currently included in the standard list of teaching aids and equipment for educational and general purposes for classrooms of natural and mathematical subjects in general educational institutions and should provide, subject to their use, an improvement in the quality of both the process of teaching natural disciplines, and students performing practical/laboratory work. However, not all schools are provided with the necessary equipment and qualified teachers. Therefore, the use of digital measuring systems and individual tools should be used in the first years of higher education institutions, for example, when studying certain disciplines (in this case, we consider physics), conducting alignment courses for first-year students, and also when conducting career guidance work with high school students [6].

The use of digital measuring computer complexes in the educational process is aimed at:

- increasing the level of motivation and cognitive activity of students,
- formation of students' readiness to use their knowledge in real life situations (to study the real world by modeling various processes),
- implementation of the tasks of intellectually directed pedagogy as a means of development and self-development of students in an ICT-saturated environment,
- changing the ways of interaction between students and teachers in the course of joint activities.

Among the main advantages of a *teacher*'s work with digital equipment, it is worth highlighting: reducing the time for preparing and conducting laboratory and practical work in physics

(if the teacher has sufficient experience working with digital devices), expanding the range of laboratory and practical work on various topics as part of lesson planning and extracurricular educational activities, the possibility of developing author's projects of laboratory work and demonstration experiments. For *students*, this is an opportunity to unlock their creative potential in the study of the disciplines of the environmental cycle, as well as in research activities.

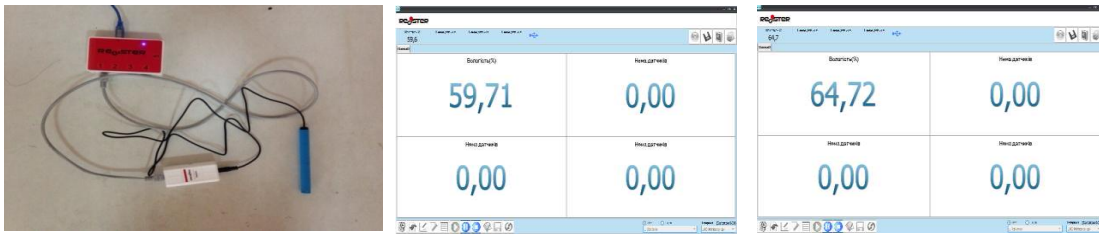
Popular today digital laboratories and measuring complexes: Einstein, LabDisc, Pasco, Relabm L-micro, FourierEdu – NOVA Link, NOVA 5000, SAC "AFS" ("All For School"), TsIKK based on the data logger Register Data Logger COBRA 3 and COBRA 4 showed high efficiency of use in schools of physics and mathematics profile and institutions of higher education.

The use of digital laboratories and measuring complexes with digital sensors allows teachers and students to conduct a wide range of research, demonstration and laboratory work, as well as to carry out research projects that contribute to the solution of interdisciplinary problems.

Let us give examples of the use of digital laboratories and digital measuring computer systems in the performance of laboratory work and educational projects in physics. As an example, consider the laboratory work "Measurement of relative humidity", performed using digital sensors based on the Register Data Logger.

The instruction for the laboratory work contains the topic, purpose, equipment (personal computer / laptop with the RegisteriLab v.8.0 software installed; Register data logger; sets of connecting wires for sensors; humidity sensor), theoretical information, installation description, work progress, control questions.

Having assembled the experimental setup according to figure 1a, the student observes automatic data recording (sensor readings are displayed on the screen in real time), fixing the value of the relative humidity in the room (figure 1b) and outdoors (figure 1c). The student compares the obtained values of relative humidity indoors and outdoors, draws conclusions.



a *b* *c*

Figure 1: Experimental setup and sensors' data.

Interesting and informative is the interdisciplinary project "Checking drinking water", during which the conductivity of different water samples is determined and compared (with Cobra4: the conductivity sensor is connected directly to the Cobra4 wireless line, Cobra4 Mobile Link or USB-Link Cobra4 with the appropriate software). The measurement data are transferred to a computer for analysis, displayed on the screen in real time, and a graphical display of the data is made (figure 2).

Students may be asked to measure and compare the conductivity value of drinking tap water samples in different locations; compare with bottled drinking water; try to explain the reason

Figure 2: Investigation of the conductivity of different water samples.

Figure 3: Measurement of conductivity values of drinking water samples at home.

for the difference in the obtained values of the conductivity of water samples. This experience shows how drinking water can vary from place to place in the same region. Research can be carried out both in a school laboratory and at home (figure 3).

Determining the ways of development of IoT, as well as the implementation of its ideas in the educational process, is very important for the informatization of education in general and the development of an open information and educational environment in particular.

Further psychological and pedagogical research requires the use of various components of the Internet of Things in the educational process: digital devices, including mobile-oriented ones, services, networks and cloud computing.

References

[1] Gershenfeld, N., Krikorian, R. and Cohen, D., 2004. The Internet of Things. *Scientific American*, 291(4), pp.76–81. Available from: https://doi.org/10.1038/scientificamerican1004-76.

[2] Globa, L.S., Ishchenko, I., Gvozdetska, N., Zakharchuk, A. and Zvonarov, O., 2016. An approach to the Internet of Things system with nomadic units developing. *2016 IEEE International Black Sea Conference on Communications and Networking (BlackSeaCom)*. pp.1–5. Available from: https://doi.org/10.1109/BlackSeaCom.2016.7901587.

[3] Gope, P. and Hwang, T., 2016. BSN-Care: A Secure IoT-Based Modern Healthcare System Using Body Sensor Network. *IEEE Sensors Journal*, 16(5), pp.1368–1376. Available from: https://doi.org/10.1109/JSEN.2015.2502401.

[4] HFS Research, 2017. Enterprise Automation and AI will reach $10 billion in 2018 to engineer the OneOffice. Available from: https://www.hfsresearch.com/digital-transformation/automation-ai-forecast_110417/.

[5] Kuzminska, O., Mazorchuk, M., Morze, N., Pavlenko, V. and Prokhorov, A., 2019. Study of digital competence of the students and teachers in Ukraine. In: V. Ermolayev, M.C. Suárez-Figueroa, V. Yakovyna, H.C. Mayr, M. Nikitchenko and A. Spivakovsky, eds. *Information and communication technologies in education, research, and industrial applications*. Cham: Springer International Publishing, pp.148–169. Available from: https://doi.org/10.1007/978-3-030-13929-2_8.

[6] Merzlykin, O.V., Semerikov, S.O. and Sokolyuk, O.M., 2018. Theoretical and methodological foundations of the using cloud technologies as a tool of high school students' research competencies forming in profile physics learning. *Theory and methods of learning mathematics, physics, informatics*, 16(3), pp.3–293. Available from: https://doi.org/10.55056/tmn.v16i3.1030.

[7] Miz, V. and Hahanov, V., 2014. Smart traffic light in terms of the cognitive road traffic management system (CTMS) based on the Internet of Things. *Proceedings of IEEE East-West Design Test Symposium (EWDTS 2014)*. pp.1–5. Available from: https://doi.org/10.1109/EWDTS.2014.7027102.

[8] Nechypurenko, P.P. and Soloviev, V.N., 2018. Using ict as the tools of forming the senior pupils' research competencies in the profile chemistry learning of elective course "Basics of quantitative chemical analysis". *Ceur workshop proceedings*, 2257, pp.1–14.

[9] Porter, J.R., Morgan, J.A. and Johnson, M., 2017. Building automation and IoT as a platform

for introducing STEM education in K-12. American Society for Engineering Education, vol. 2017-June. Available from: https://doi.org/10.18260/1-2--27987.

[10] Raza, U., Kulkarni, P. and Sooriyabandara, M., 2017. Low power wide area networks: An overview. *IEEE Communications Surveys Tutorials*, 19(2), pp.855–873. Available from: https://doi.org/10.1109/COMST.2017.2652320.

[11] Rhee, S., Nam, I. and Im, S., 2018. A relationship between scientific key competencies and achievement standards in physics under the 2015 revised national curriculum of Korea. *New physics: Sae mulli*, 68(10), pp.1081–1095. Available from: https://doi.org/10.3938/NPSM.68.1081.

[12] Sklyar, V., 2017. Vedic Mathematics as Fast Algorithms in Green Computing for Internet of Things. In: V. Kharchenko, Y. Kondratenko and J. Kacprzyk, eds. *Green IT Engineering: Components, Networks and Systems Implementation*. Cham: Springer International Publishing, pp.3–21. Available from: https://doi.org/10.1007/978-3-319-55595-9_1.

[13] Statista, 2018. Number of IoT devices 2015-2025. Available from: https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/.

[14] The Boston Consulting Group/Google, 2017. Mobile Marketing and the New B2B Buyer. Available from: https://www.thinkwithgoogle.com/marketing-strategies/app-and-mobile/b2b-search-statistics/.

[15] Yang, G., Xie, L., Mäntysalo, M., Zhou, X., Pang, Z., Xu, L.D., Kao-Walter, S., Chen, Q. and Zheng, L.R., 2014. A Health-IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor, and Intelligent Medicine Box. *IEEE Transactions on Industrial Informatics*, 10(4), pp.2180–2191. Available from: https://doi.org/10.1109/TII.2014.2307795.

[16] Zhu, Q., Wang, R., Chen, Q., Liu, Y. and Qin, W., 2010. IOT Gateway: BridgingWireless Sensor Networks into Internet of Things. *2010 IEEE/IFIP International Conference on Embedded and Ubiquitous Computing*. pp.347–352. Available from: https://doi.org/10.1109/EUC.2010.58.